NOTES, ABSTRACTS, AND REVIEWS.

EXCHANGE OF METEOROLOGICAL REPORTS BY RADIO.

An agreement has been entered into whereby daily meteorological reports from 30 stations in the United States and Canada have been transmitted by radio since June 15, 1922, to the National Meteorological Service of France. These reports are broadcast through the Eiffel Tower on the day of receipt. In return, the United States Weather Bureau receives daily from the French Meteorological Service reports from 30 stations in Europe. In addition to the above, daily reports of weather conditions have been received almost daily since June 23, 1922, from Amundsen's polar expedition ship *Maud* and will continue to be received so long as the ship is within reach of American stations.

ABERDEEN AND BENSON.

[Excerpts from *Meteorological Magazine*, London, July, 1922.]

The past month is remarkable for the announcement of two retirements; that of Prof. Charles Niven, F.R.S., from the professorship of natural philosophy at Aberdeen, to which was attached the care (on behalf of the Meteorological Office) of the Meteorological Observatory at Kings College; and that of Mr. W. H. Dines, F.R.S., from the direction and management of the Aerological Observatory at Benson. * * *

Mr. W. H. Dines is also a link with the past. Devoted to the study of meteorology as a family tradition and endowed with all the qualifications that are implied by a training in mechanical engineering, a Wranglers' degree at Cambridge, long experience in teaching of mathematics, the habit of mind which sees what is there, no more and no less, and a personal knowledge of the ways of meteorology in society, he was exactly qualified to undertake the direction and management of an observatory for the upper air, and after some experience with kites at Oxshott, he took on charge the work on the Upper Air for the Meteorological Office in return for out-of-pocket expenses and a small honorarium which was not large enough to interfere with his sense of freedom. * * *

Mr. Dines's summary in the *Characteristics of the Free Atmosphere* [1] is remarkable evidence of personal achievement. Reference was constantly made to the facts and summaries given therein during the development of aircraft and engines. An appreciation of Mr. Dines's services to science and the State might very well be expressed otherwise, but he has at least the satisfaction of knowing that if the achievement of the maximum result with the minimum of cost is to be regarded as good service, none is better than his.

Mr. Dines began with the study of wind, went on to the upper air, and at the end of his official service finds himself embroiled in radiation. With his unwillingness to accept what he can not verify he is still busy with the distribution of temperature in the atmosphere. If he will recall what a crazy patchwork the science of meteorology was acknowledged to be when he began his active share in it in the "seventies" and how much he has contributed to making it a tissue with a pattern in it, he can not fail to find encouragement to pursue this study of radiation in his retirement, with the assurance that the interest which those who look on take in his work increases and will increase with his increasing years.—*Napier Shaw.*

[1] *Geophysical Memoirs* No. 13, M. O. 220c, 1919.

EVAPORATION AND PRECIPITATION ON THE EARTH.[1]

By DR. GEORG WÜST.

[Abstracted from *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, No. 1–2, 1922.]

Accepting the values for precipitation, run-off, and evaporation given by Fritzsche [2] for the region between 60° N. latitude and 40° S. latitude, and supplementing these by assigning values for the regions poleward, there is obtained for the total evaporation from the land 75,000 km³/year, or 50.4 cm./year, and for the run-off 37,100 km³/year. By introducing these values in Brückner's fundamental equation $R_e = V_e + F$ (precipitation on land equals evaporation on land plus run-off) the total precipitation on the land is found to be 112,000 km³/year, or 75.3 cm./year.

Relative to evaporation on the ocean two methods of determination are discussed. In the indirect method by W. Schmidt there is determined from the different radiation energies the amount of heat available for evaporation and convection. An apportionment of this heat to the two processes gives a theoretical value for evaporation amount and with this there is obtained the probable reduction factor of 0.43 for reducing to sea surface the observations of evaporation made on ships. The direct method of comparison employed by the author showed that evaporation values at the sea surface are 44 per cent less than those observed on ships (elevation 6 meters); hence the reduction factor of 0.56, which is considered maximum. From a discussion of the influences surrounding the evaporation vessel 0.40 is assumed as minimum value of the factor, and it is written 0.48 ± 0.08. To the reduction factor 0.48 there corresponds an evaporation of 84 cm./year (limit of error 10 per cent).

Brückner [4] in his investigation of evaporation carried out for large basins and reservoirs found the value of 105 cm./year. According to Bigelow,[5] who by comparative measurements derived ratios for vessels of different sizes, even for these water surfaces a reduction factor proves necessary. From a tabular statement Bigelow's reduction factor for Brückner's values is found to be 0.82, and the amount 105 cm./year is reduced to 86 cm./year. The application of this value to oceanic evaporation assumes that relative to evaporation climatic conditions are the same on land and sea in the same zone. However, this is not the case; lower wind velocity over water surfaces of the land gives lower evaporation and lower vapor pressure over the same gives greater evaporation than at sea. Since the author was able to show [6] that these effects neutralize each other in large degree Brückner's values for free water surfaces of the land, when reduced, come comparatively near the true oceanic evaporation and lie within the limits previously given.

The value of 84 cm./year gives 304,200 km.³/year for oceanic evaporation. Introducing this in Brückner's fundamental equation $R_m = V_m - F$ (oceanic precipitation equals oceanic evaporation less run-off) we find 267,100 km.³/year for oceanic precipitation. This corresponds to 74.2 cm./year.

[1] *Verdunstung und Niederschlag auf der Erde.*
[2] *Niederschlag, Abfluss und Verdunstung auf den Landflächen der E. Diss.*, Halle, 1906.
[3] Strahlung und Verdunstung an freien Wasserflächen, ein Beitrag zum Wärmehaushalt des Weltmeeres und zum Wasserhaushalt der Erde. *Ann. d. Hydr. usw*, 1915.
[4] Die Bilanz des Kreislaufes des Wassers auf der Erde. *Geogr. Zeitschr.*, 1905.
[5] The laws of the evaporation of water from pans, reservoirs and lakes, sand, soil and plants. *Bulletin Argentine Meteorological Office*, 1912.
[6] Die Verdunstung auf dem Meere. *Veröff. d. Inst. f. Meereskunde.* N. F. Reihe A, Heft 6, 1920 (S. 85).

The zonal values found by von Kerner[7] lead to the "considerably too high" value of 363,240 km.³/year, or 100.6 cm/year for oceanic precipitation. Assuming that von Kerner's values render correctly the zonal distribution of precipitation at sea they are retained, but are reduced in the ratio 74.2 : 100.6 (factor 0.734).

Relative to the following table: "Even if the zonal amounts are only approximate values the final totals can yet lay claim to a high decree of probability. The zonal values are probably of value in many questions, since they are comparable among themselves."

TABLE 1.—*Zonal distribution of evaporation and precipitation on the earth (calculated on the basis of results of investigation by Fritzsche, von Kerner, and Wüst).*

OCEAN.

Zone.	Area[9] (10 ⁶ km.²).	Mean depth (cm./year).			Amounts in 1,000 km.³/year.	
		N[1]	*V*	*N*−*V*	*N*[8]	*V*
°N.—						
90–80	3.5	*(15)	*(5)	*(10)	*(0.5)	*(0.2)
80–70	8.2	(29)	(9)	(20)	(2.4)	(0.7)
70–60	5.6	48	12	36	2.7	0.7
60–50	10.9	96	40	**56**	10.4	4.4
50–40	15.0	**117**	70	47	**17.6**	10.5
40–30	20.8	51	96	−45	10.7	20.0
30–20	25.1	*22	115	*−93	*5.5	28.9
20–10	31.5	62	**120**	−58	19.7	**37.8**
10–0	34.0	**140**	*100	**40**	**47.5**	*34.0
°S.—						
0–10	33.7	95	114	−19	32.2	38.4
10–20	33.4	66	**120**	−54	22.2	**40.1**
20–30	30.9	*51	112	*−61	*15.9	34.6
30–40	32.3	88	89	−1	**28.6**	28.8
40–50	30.5	**92**	58	34	28.0	17.7
50–60	25.4	70	23	**47**	17.7	5.8
60–70	17.1	(29)	(9)	(20)	(5.0)	(1.5)
70–80	3.1	*(15)	*(5)	*(10)	*(0.5)	*(0.2)
80–90	0.0	0	0	0	0.0	0.0
90° N. to 90° S.	361.1	74.2	84.2	−10.0	267.1	304.2

LAND.

Zone.	Area[9] (10 ⁶ km.²).	Mean depth (cm./year).			Amounts in 1,000 km.³/year.	
		N[1]	*V*	*N*−*V*=*F*	*N*[8]	*V*
°N.—						
90–80	0.4	(34)	*(5)	(29)	*(0.1)	*(0.0)
80–70	3.4	*(26)	(9)	(17)	(0.9)	(0.3)
70–60	13.3	35	(12)	(23)	4.7	(1.6)
60–50	14.7	50	36	*14	7.4	5.3
50–40	16.5	51	33	18	8.4	5.5
40–30	15.6	52	38	14	8.1	5.9
30–20	15.1	79	50	29	11.9	7.6
20–10	11.3	95	79	16	10.7	8.9
10–0	10.1	172	115	57	17.4	1.6
°S.—						
0–10	10.4	**181**	**122**	**59**	**18.8**	**12.7**
10–20	9.4	110	90	20	10.3	8.5
20–30	9.2	64	*41	23	6.0	3.8
30–40	4.1	*57	51	*6	2.3	2.1
40–50	1.0	87	(50)	(37)	0.9	(0.5)
50–60	0.2	**102**	(20)	(82)	0.2	*(0.0)
60–70	0.8	(30)	(10)	(20)	*(0.2)	(0.1)
70–80	8.5	(30)	(5)	(25)	(2.6)	(0.4)
80–90	3.9	*(30)	*(5)	(25)	(1.2)	(0.2)
90° N. to 90° S.	148.9	75.3	50.4	24.9	112.1	75.0

[7] Eine neue Schätzung des Gesamtniederschlages auf den Meeren. *Mitt. d. k. k. geogr. Gesellschaft in Wien.* Bd. 61, 1918.
[8] Van Kesner's zonal values reduced by the factor 0.734.
[9] Areas according to H. Wagner and E. Kossina.

TABLE 1.—*Zonal distribution of evaporation and precipitation on the earth (calculated on the basis of results of investigation by Fritzsche, von Kerner, and Wüst*—Continued.

ENTIRE EARTH.

Zone.	Area[9] (10 ⁶ km.²).	Mean depth (cm./year).			Amounts in 1,000 km.³/year.	
		N[1]	*V*	*N*−*V*	*N*[8]	*V*
°N.—						
90–80	3.9	*(17)	*(5)	(12)	*(0.6)	*(0.2)
80–70	11.6	(29)	(9)	(20)	(3.3)	(1.0)
70–60	18.9	(39)	(12)	(27)	7.3	(2.3)
60–50	25.6	69	38	31	17.8	9.7
50–40	31.5	**83**	51	**32**	**26.0**	15.9
40–30	36.4	51	71	−20	18.8	25.9
30–20	40.2	*43	91	*−48	*17.4	36.4
20–10	42.8	71	**109**	−38	30.5	**46.7**
10–0	44.1	**147**	*103	**44**	**64.9**	*45.6
°S.—						
0–10	44.1	116	**116**	0	51.0	**51.2**
10–20	42.8	76	113	−37	32.5	48.5
20–30	40.2	*54	96	*−42	*21.9	38.4
30–40	36.4	85	85	0	**30.9**	30.8
40–50	31.5	**92**	58	34	28.9	18.2
50–60	25.6	70	23	**47**	17.9	5.9
60–70	18.9	(28)	(9)	(19)	(5.2)	(1.6)
70–80	11.6	*(26)	(7)	(19)	(3.1)	(0.6)
80–90	3.9	(30)	*(5)	(25)	*(1.2)	*(0.2)
90° N. to 90° S.	510.0	74.3	74.3	0.0	379.2	379.2

N, precipitation; *V*, evaporation; *F*, run-off.
Maxima in boldface type, minima with asterisks, hypothetical values in parentheses.

Attention is called to the following features shown in the table: (1) Secondary maximum of precipitation at sea in the zones of the variable winds (40° to 50° lat.) separated from the absolute maximum at the Equator by the extremely dry subtropics; (2) increase in evaporation equatorward interrupted at sea by secondary minimum in the "belt of calms"; (3) considerable excess (in cms.) of oceanic evaporation over land evaporation in subtropical and middle latitudes, values of the same magnitude for tropical latitudes; (4) difference in the amount *N*−*V* on land and sea—excess of evaporation over precipitation on the sea at 10° to 40° N. latitude and at 0° to 30° S. latitude, decrease in *N*−*V* (run-off) from the Equator not constant on the land, desert belts are recognizable.

The paper closes with the following comparative table:

Different determinations of the hydrology of the earth.

[Amounts in 1,000 km.³/year.]

	Precipitation.			Evaporation.		
	Fritzsche-Brückner.	Schmidt-Fritzsche.	Wüst-Fritzsche.	Fritzsche-Brückner.	Schmidt-Fritzsche.	Wüst-Fritzsche.
Ocean	353.4	242.4	267.1	384.0	273.0	304.2
Land	111.9	111.9	112.1	81.3	81.3	75.0
Earth	465.3	354.3	379.2	465.3	354.3	379.2

—*W. W. R.*